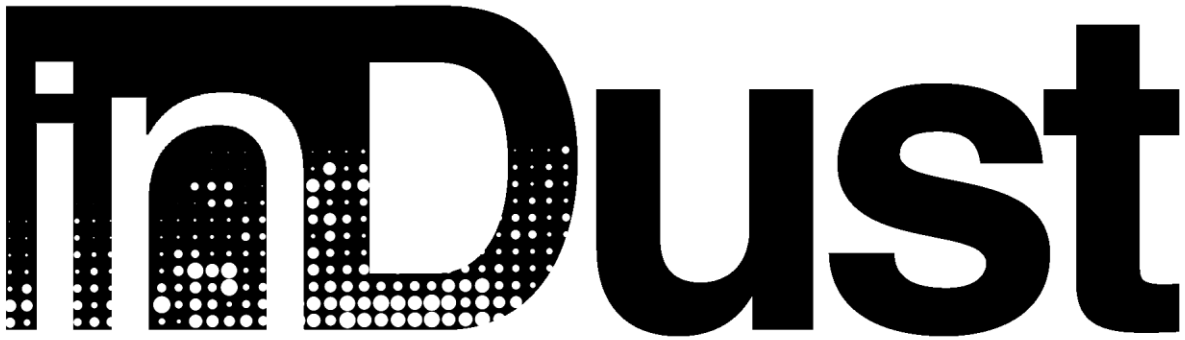
Sara Basart (BSC, Spain) on behalf of



COST Action CA16202

www.cost-indust.eu

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

AXA Research Fund

Motivation – Dust impacts

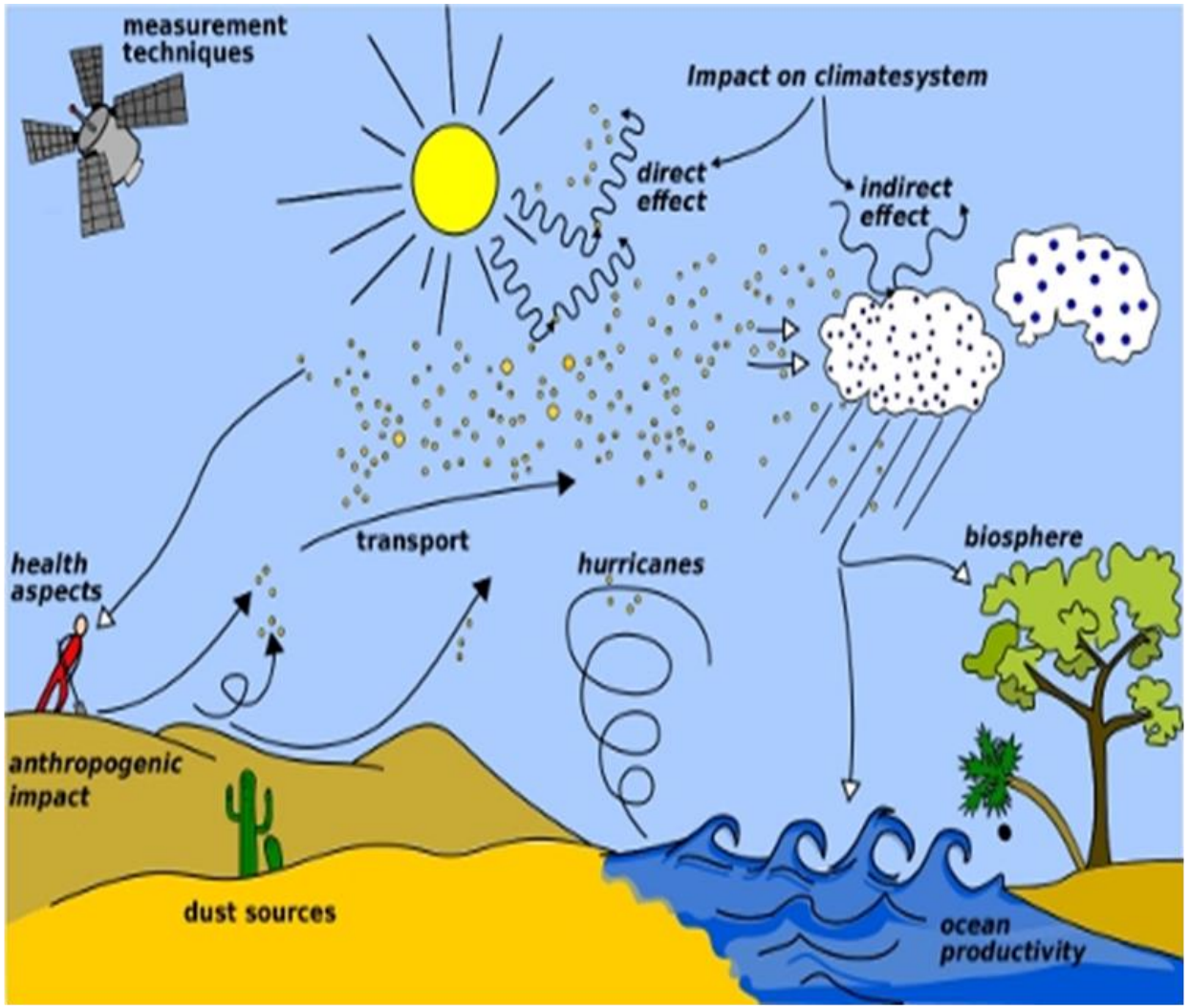
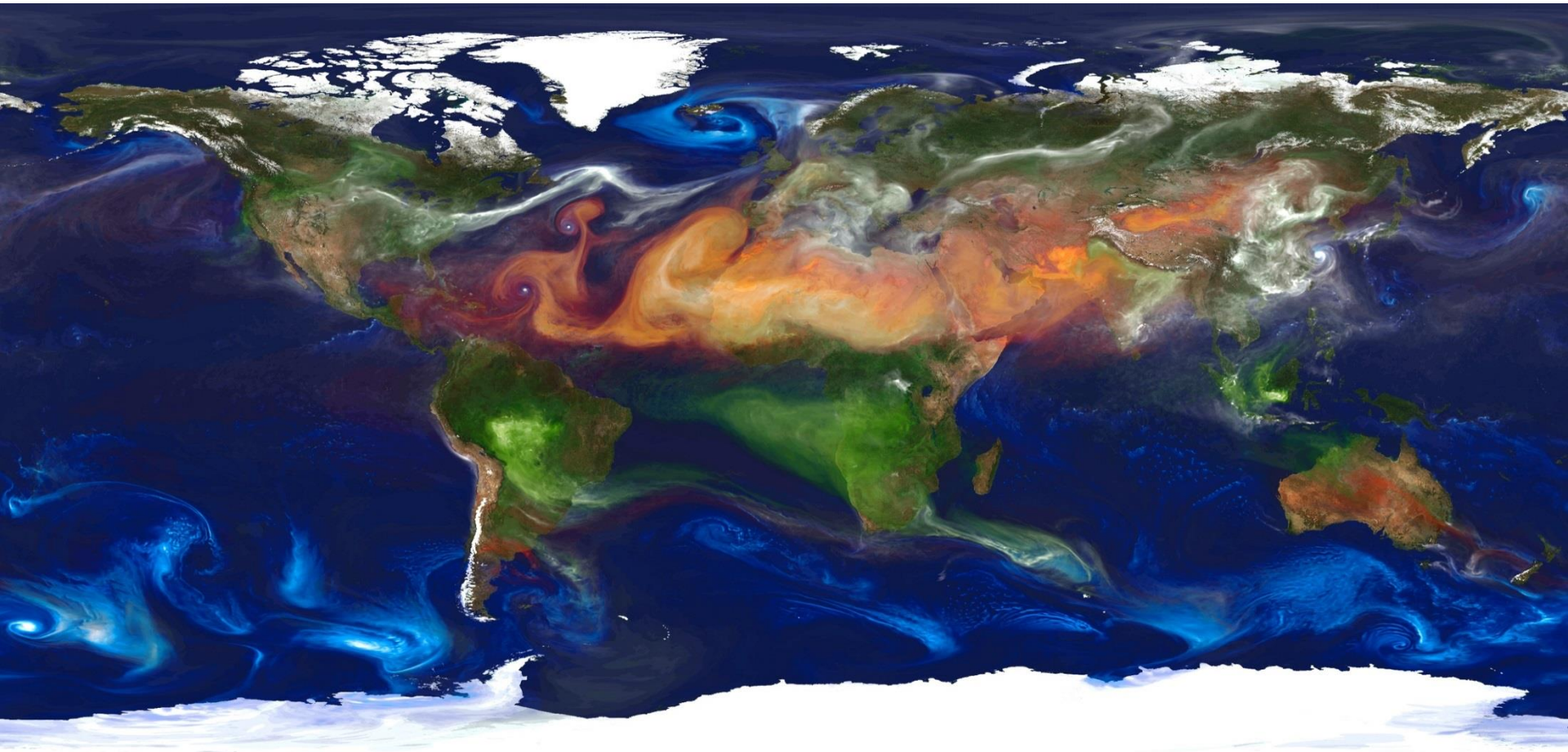


Image from WMO website (http://www.wmo.int/pages/prog/arep/wwrp/new/hurricanes.html)

Motivation – Dust impacts and its extension



Organic Carbon + Elemental carbon
Dust
Sulfate
Sea salt

A piece of SDS history

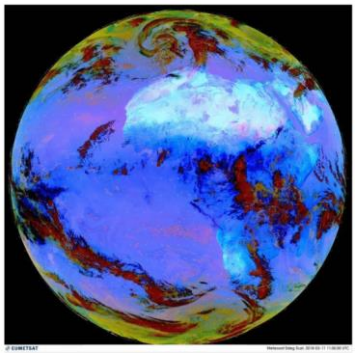
- Late 80’es:
  - First demonstration that SDS dynamic simulations are possible
- 90’es:
  - First satellite products capable to detect SDS
  - First successful daily SDS forecast test
  - First long-term daily SDS forecasts
- 2000’s:
  - Fast growth in dust observations and forecasting models
- 2010’s:
  - Fast growth in user-oriented applications

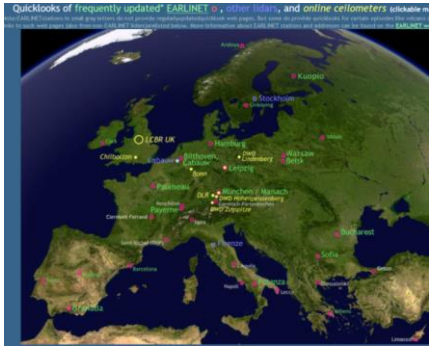
Methodologies and products – Illustrative examples

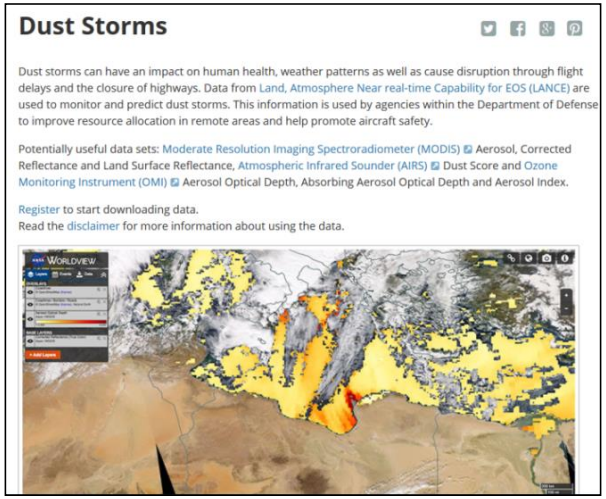
- Operational forecasts
  - SDS-WAS North Africa – Middle East – Europe Activity Node (12 daily forecasts + 1 ensemble composite)
- Observations and GEO datasets
  - Validation of models
  - Data assimilation
  - Better understanding SDS process
  - Specification of lower boundary conditions in models

Methodologies and products – Illustrative examples

- Observations (“Conventional”)
  - NASA AERONET network of sunphotometers
  - NASA CALIPSO aerosol/cloud profiles
  - MSG SEVIRI
  - EARLINET European lidar network
  - NASA MODIS AOD
  - …

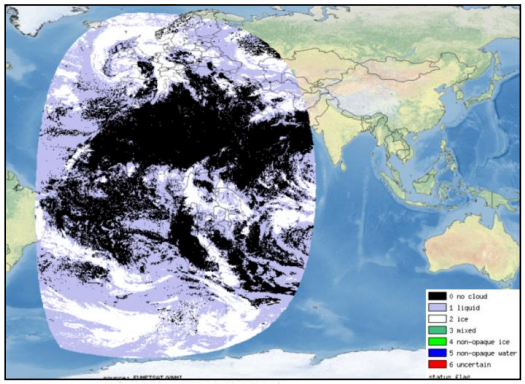


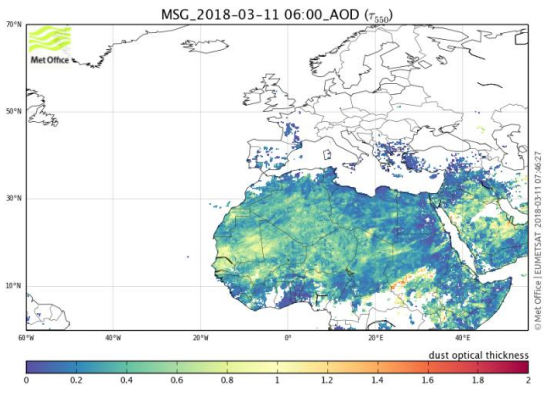


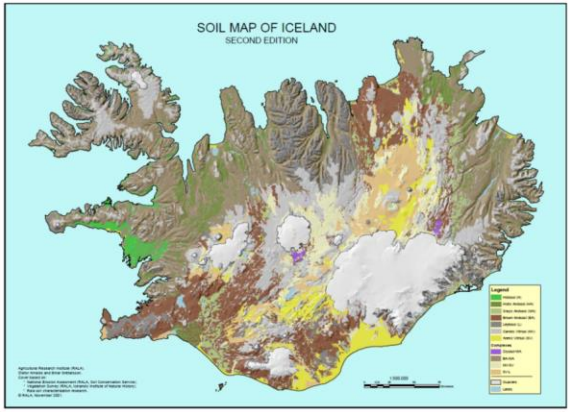


Methodologies and products – Illustrative examples

- Dust-related observations/datasets
  - MSG SEVIRI hydrometeors
  - Combined lidar and cloud radar obs (clouds+aerosol)
  - National data on sources
  - Dual-polarized radars for SDS EWS
  - Ceilometers – European network
  - MSG AOD over ground
  - Detailed soil maps/data
  - Soil minerals data

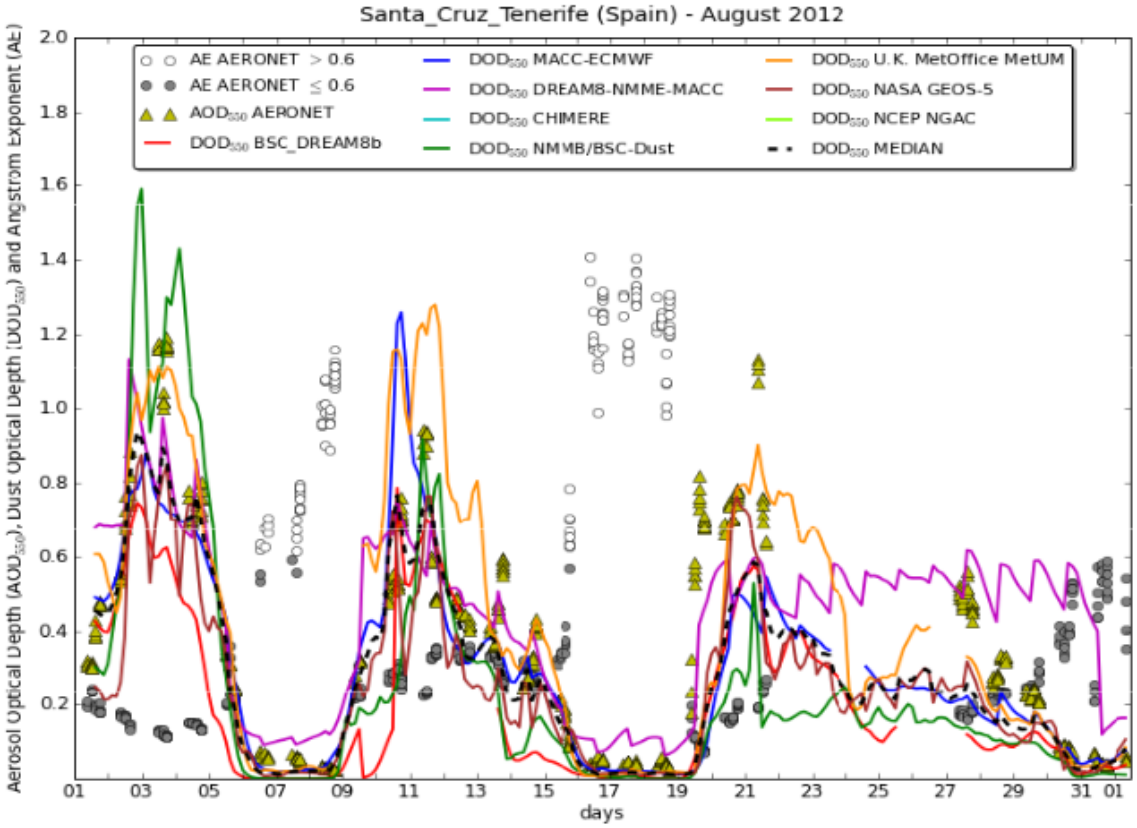






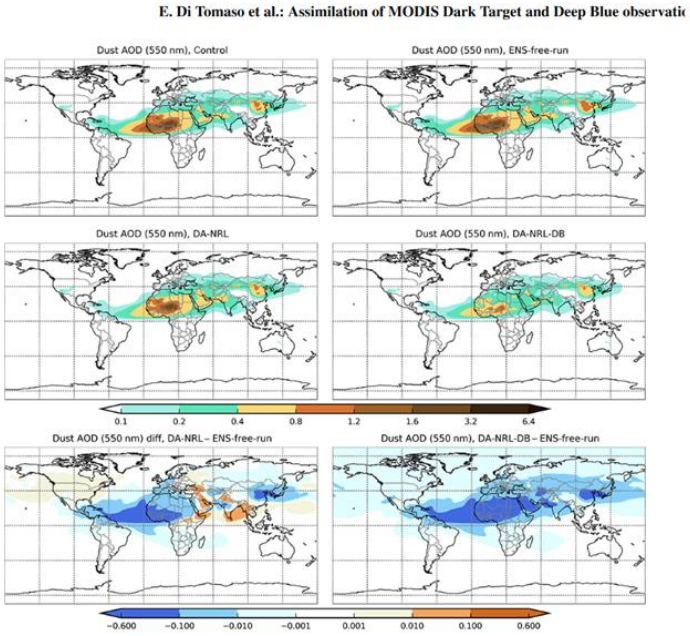
Methodologies and products – Illustrative examples

- Model validation
  - Multi-model validation: SDS-WAS multi-model ensemble

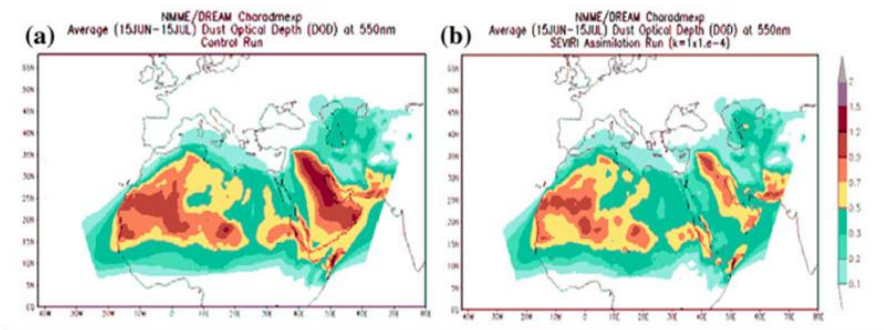


Methodologies and products – Illustrative examples

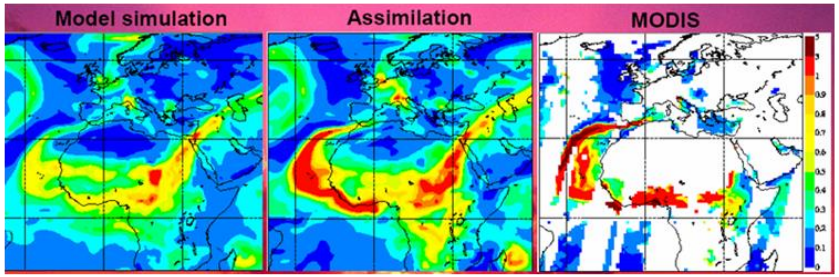
- Data Assimilation



BSC: Modis AOD



RHMSS and NOA: MSG AOD



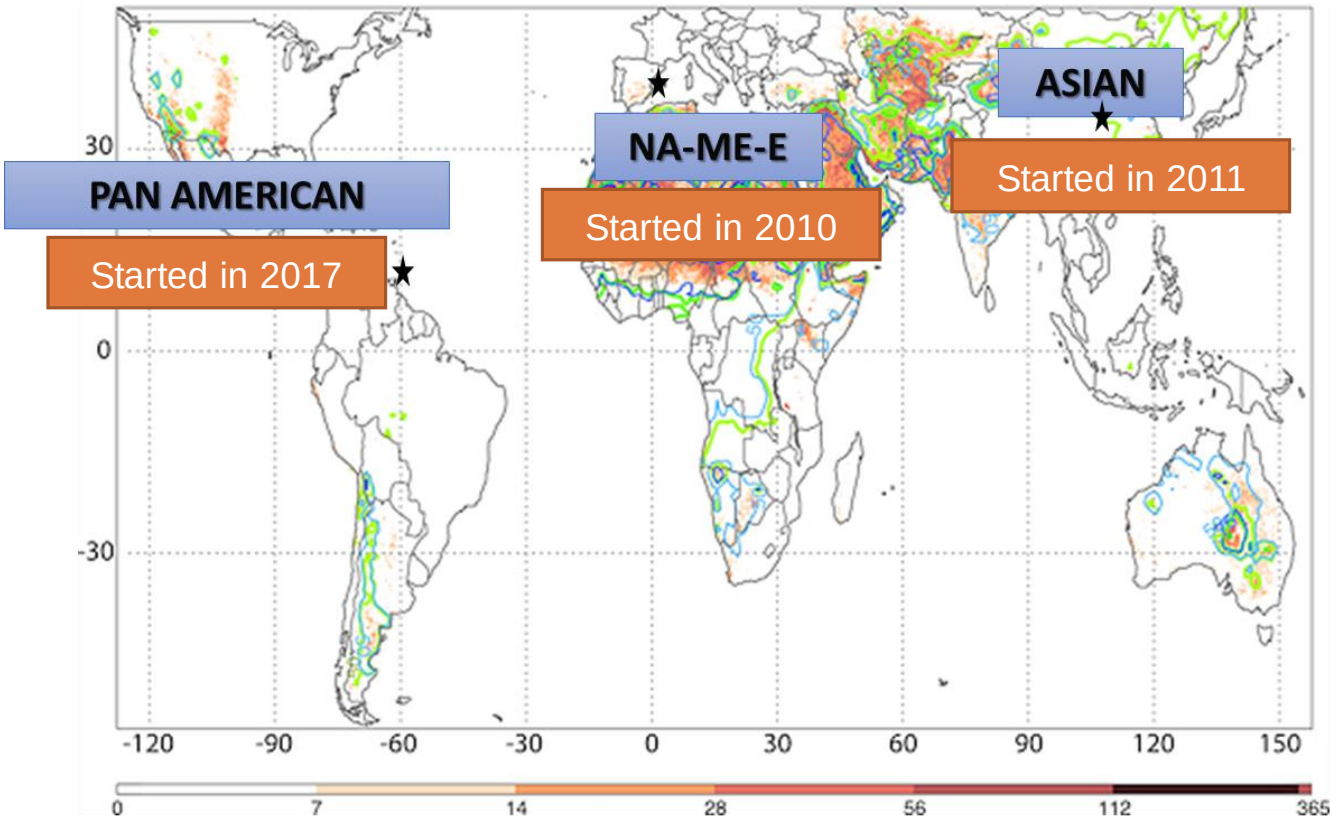
ECMWF: MODIS AOD

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

- Objectives:
  - Identify and improve products to monitor and predict dust by working with research and operational organizations, as well as with users.
  - Facilitate user access to information.
  - Strengthen the capacity of countries to use the observations, analysis and predictions provided by the WMO SDS-WAS.

WORLD METEOROLOGICAL ORGANIZATION

SDS-WAS and the Regional Nodes/Centers

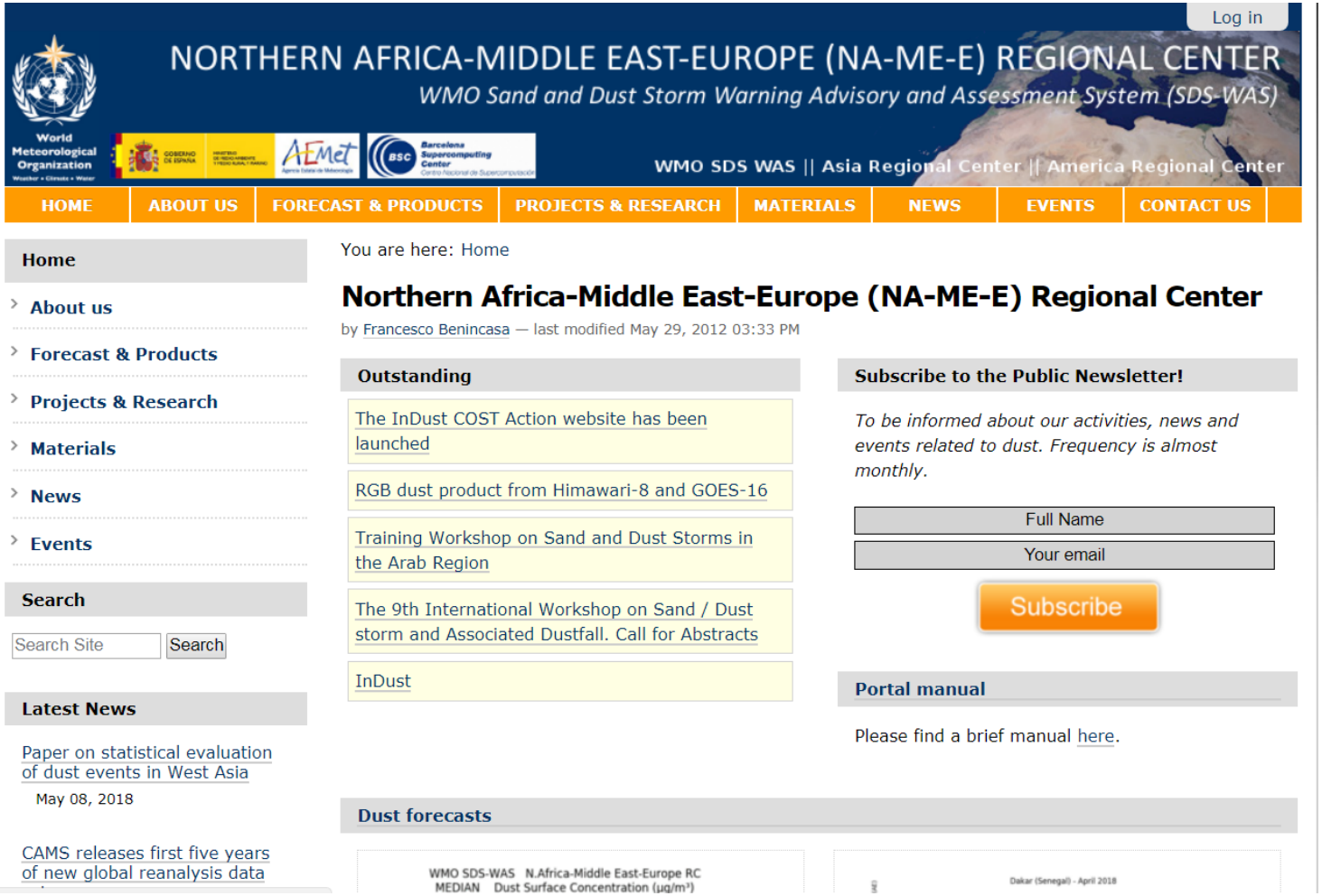


Annual mean frequency distribution of M-DB2 (2003–2009) DOD > 0.2 (red), TOMS (1980–1991) aerosol index ≥ 0.5 (blue), and OMI (2004–2006) aerosol index ≥ 0.5 (green). The isocontours of TOMS and OMI have been removed over oceans for clarity.

Extracted from Ginoux et al. (2012, Rev. Geophys.)

WORLD METEOROLOGICAL ORGANIZATION

SDS-WAS and the NAMEE Regional Center

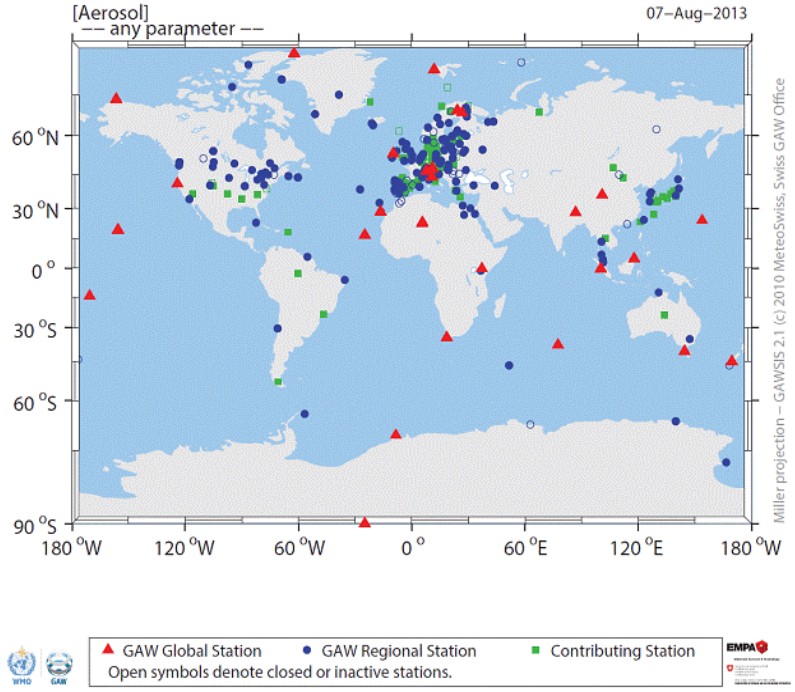


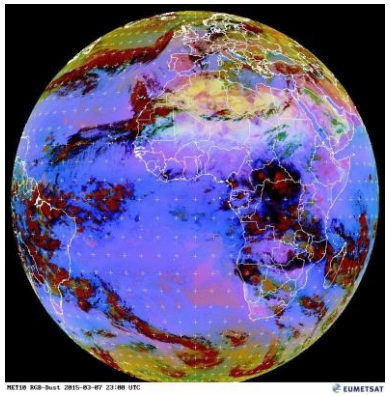
Agencia Estatal de Meteorología

http://sds-was.aemet.es/

SDS-WAS and the NAMEE Regional Center

- Observations
  - Better understanding and track of SDS → Dust-filtered observations
  - Used for model evaluation and data assimilation
  - Lack of observations, particularly in Africa

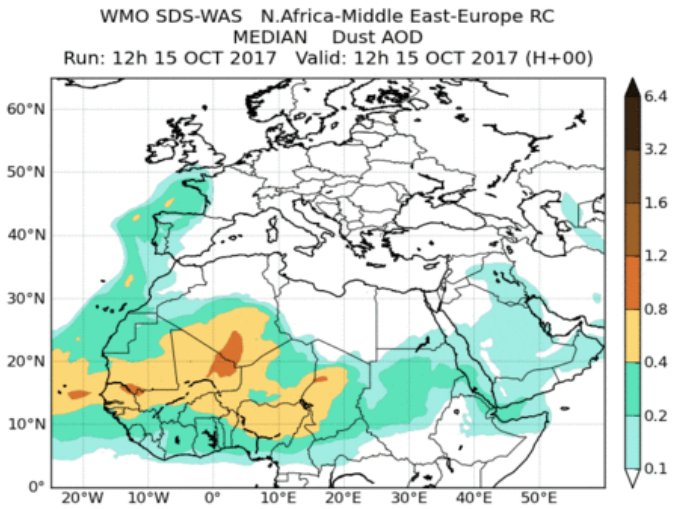




SDS-WAS and the NAMEE Regional Center

- Modelling
  - Products: surface concentration and DOD maps, the SDS-WAS multi-model product.

Operational
SDS-WAS Ensemble



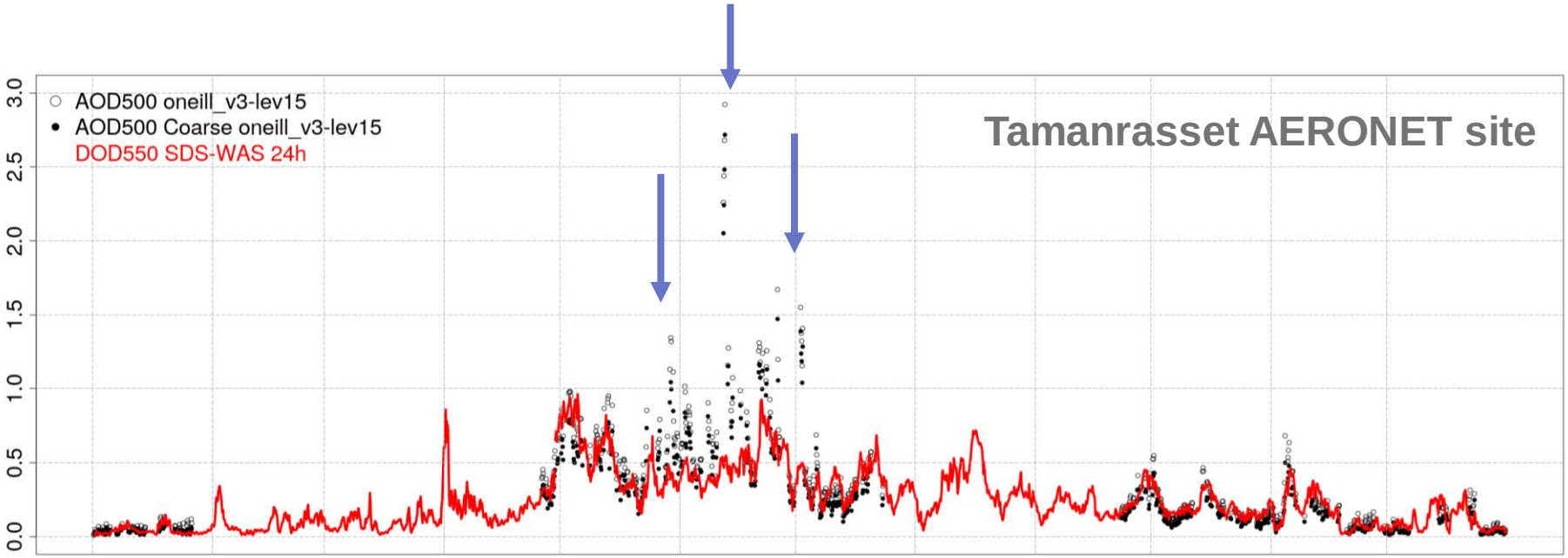
12 Global – Regional models from ~ 100 to 10 km

BSC AEMet Agencia Estatal de Meteorología

(http://sds-was.aemet.es/

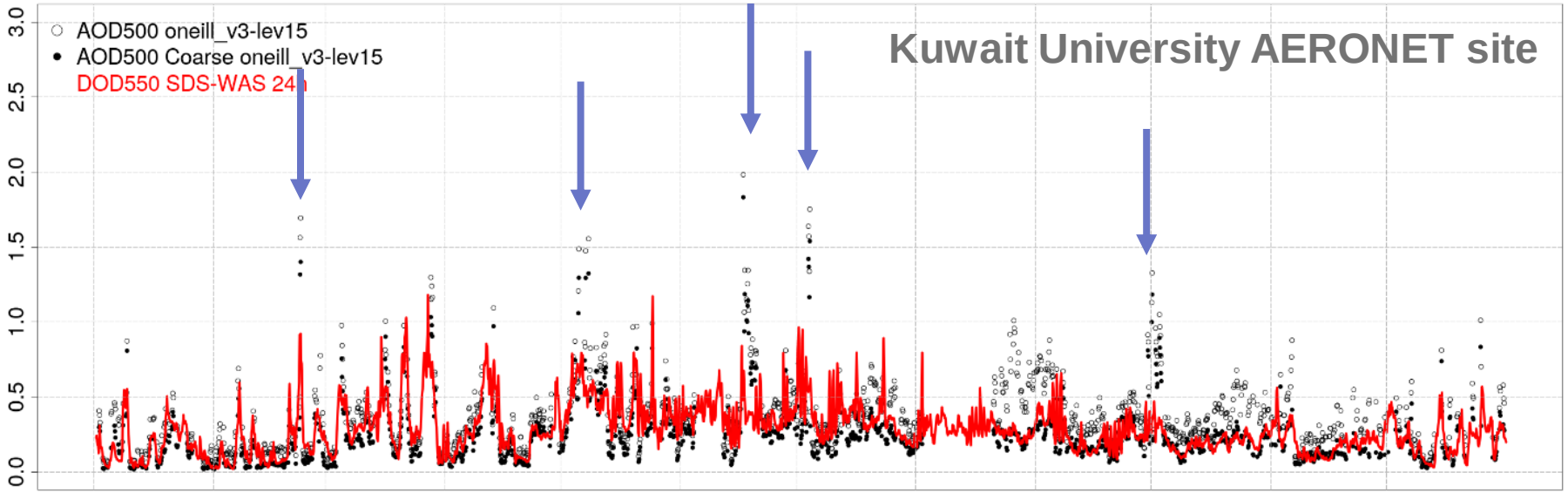
SDS-WAS and the NAMEE Regional Center

- Modelling
  - The current state-of-the art operational dust models are not able to reproduce smaller scale SDS → High-resolution simulations



SDS-WAS and the NAMEE Regional Center

- Modelling
  - The current state-of-the art operational dust models are not able to reproduce smaller scale SDS → High-resolution simulations



SDS-WAS and the NAMEE Regional Center

- Capacity building
  - Trainings focusing on the weather community and PhD Students

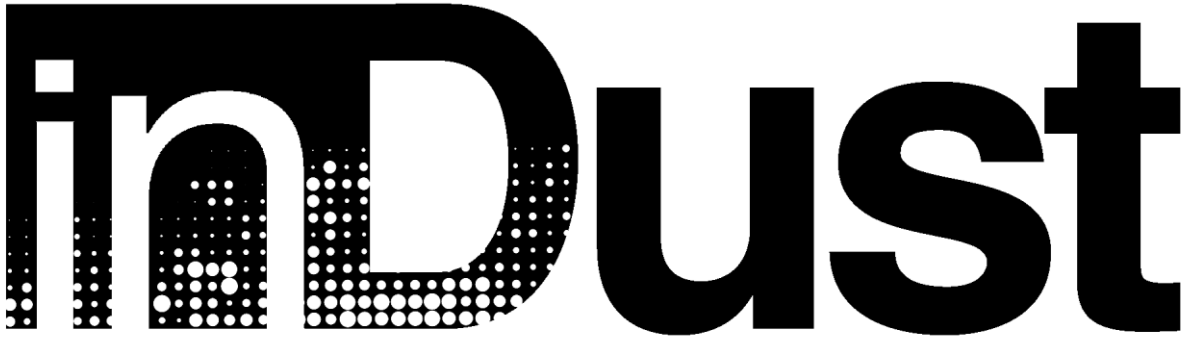
Accra
Addis-Ababa
Ankara
Antalya
Barcelona
Cairo
Casablanca
Istanbul
Madrid
Muscat
Niamey
Ouagadougou
Tehran
Tbilisi

SDS-WAS and the NAMEE Regional Center

Lessons learnt:

- Lack of coordination between measurement and modelling groups.
  - Measurement products lack harmonised quality controls, data formats and measurements schedules
    - This is more dramatic when you consider Northern African and the Middle East where we find the deserts
- Advertise about Sand and Dust Storms
  - Enhance the visibility of the dust impacts to the society at large and the most affected socio-economic sectors in particular
- Not “really” tailored user-oriented products
  - Few existing channels of communication between scientific research and user (socio-economic) communities.

International Network to Encourage the Use of Monitoring and Forecasting Dust Products



COST Action CA16202

Chair: Sara Basart (Spain)
Vice-Chair: Slobodan Nickovic (Serbia)

Period: 14 Nov 2017 – 14 Nov 2021

inDust

Our goals

- To establish a network involving research institutions, service providers and potential end

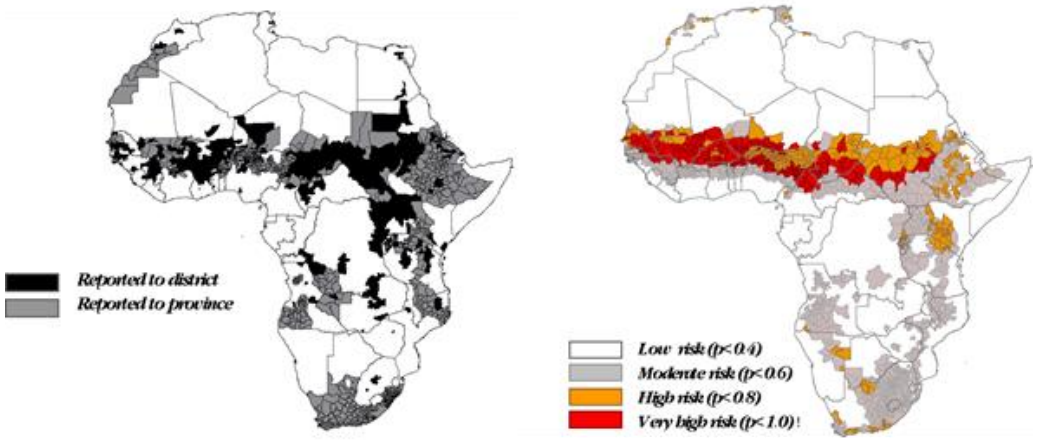
inDust is looking for dust user-oriented services

of airborne mineral dust.

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Applications: examples

- Health
  - Respiratory and cardiovascular diseases (e.g Kawasaki disease)
  - Fe as an enhancement factor in meningitis outbreaks in the Sahel and in bacterial infections in general



(Pérez García-Pando et al., 2014)

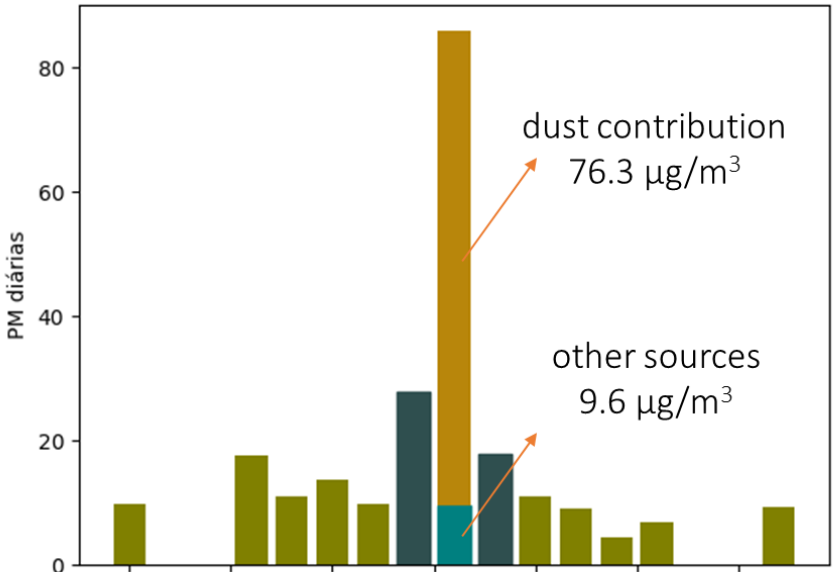
Applications: examples

- Health
  - Conjunctivitis
  - Skin irritations
  - Valley fever
  - Mortality and injuries related to transport accidents

Dunhuang, China, 23 April 2014

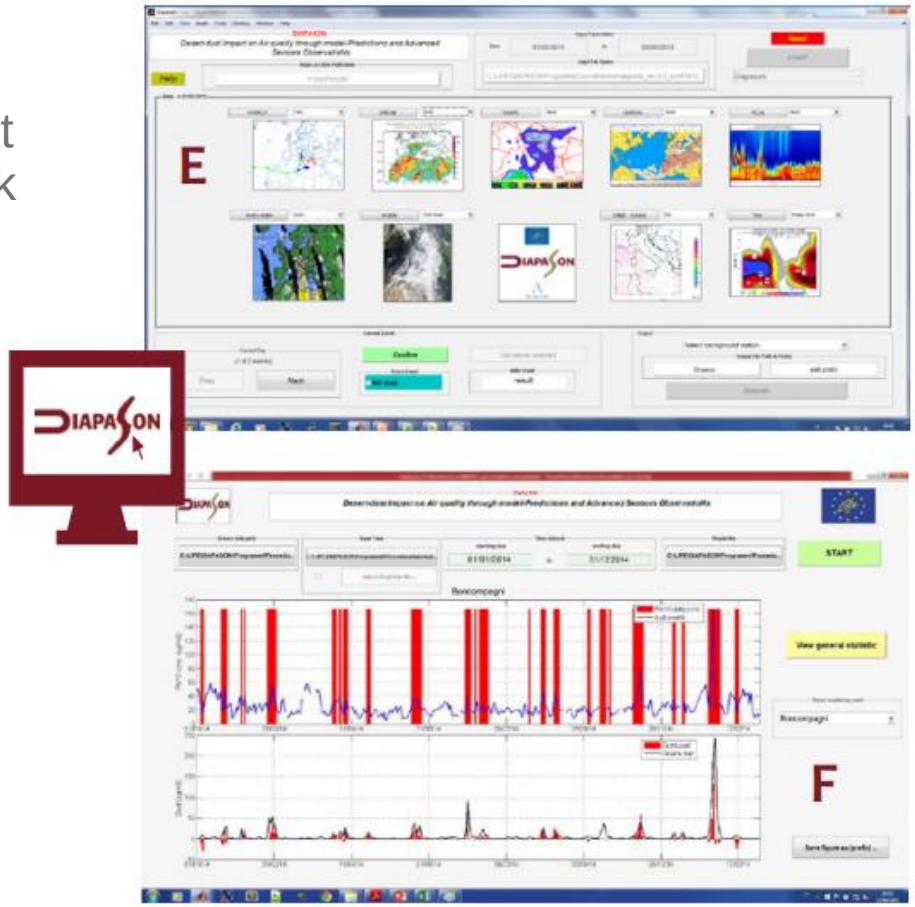
Applications: examples

- Air Quality
  - Assess the desert dust contribution to PM levels → Methods to extract desert dust contributions from the PM bulk observations



Courtesy of C. Gama

DIAPASON software to implement the EC-Methodology



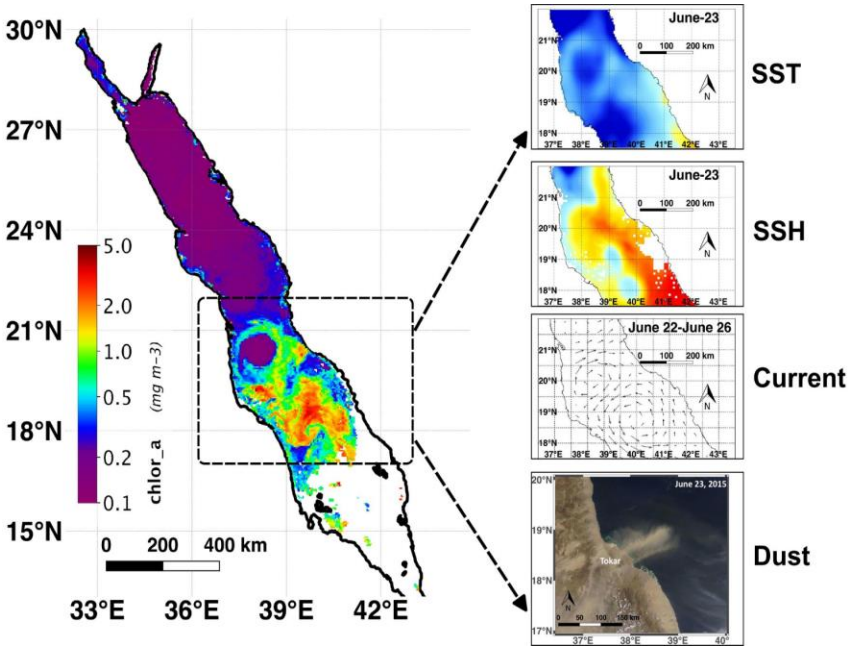
Software to implement the DIAPASON-revised Methodology

Applications: examples

- Ecosystems
  - Fe and P embedded in dust → ocean nutrients

Algie bloom due to dust/Fe

Red Sea Primary Productivity



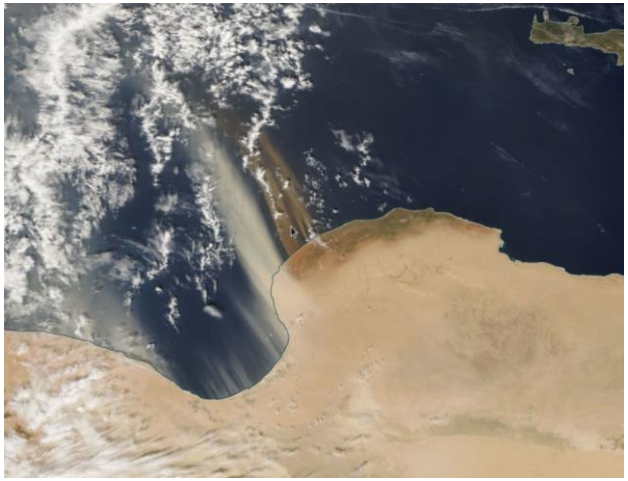
High Chlorophyll-a Event during Summer 2015
(Li et al., 2017)

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

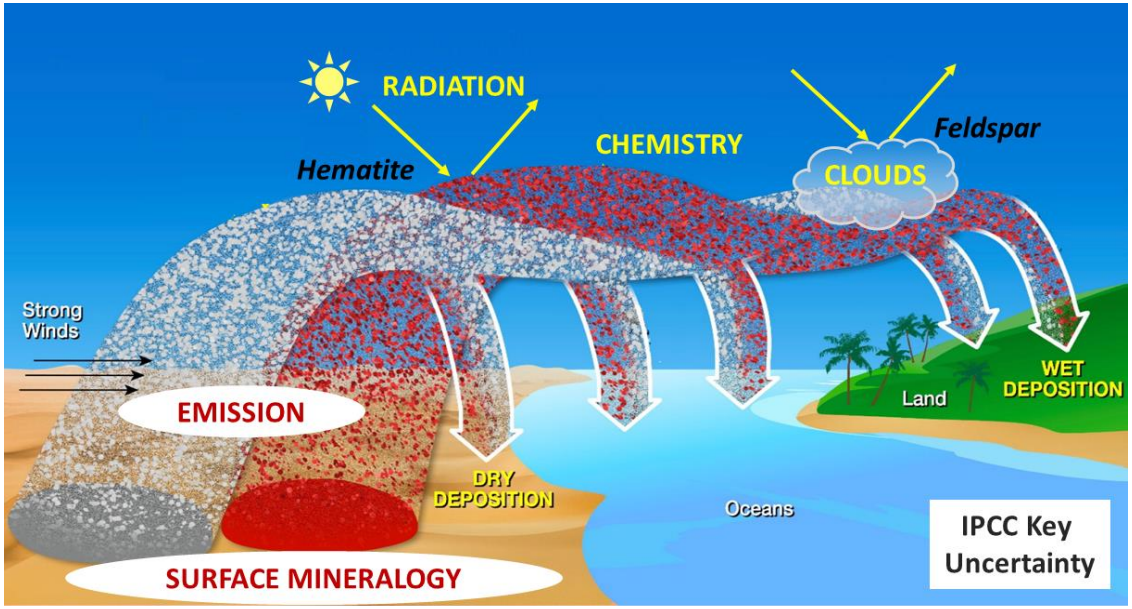
Applications: examples

- Weather and climate
  - Radiation absorption/reflection depends on dust colour (desert's composition)
  - Cloud ice nucleation sensitive to dust mineral composition

  → Better weather and climate predictions



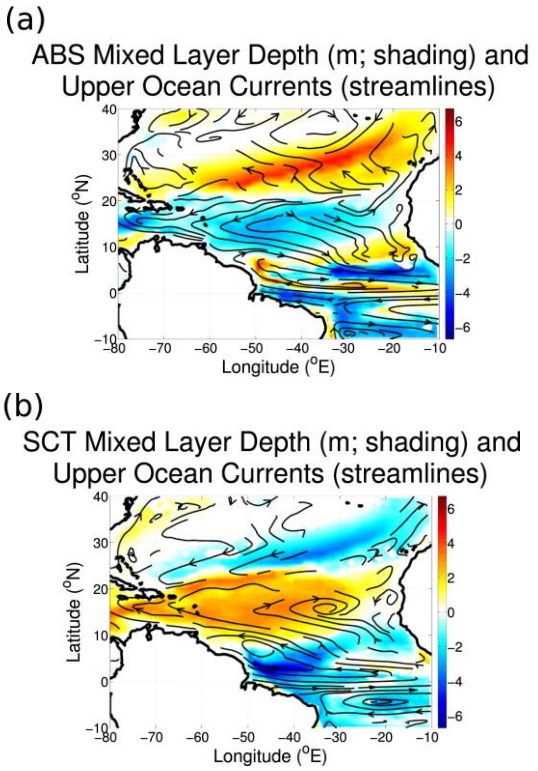
MODIS Terra, 26th Oct 2007 Libya



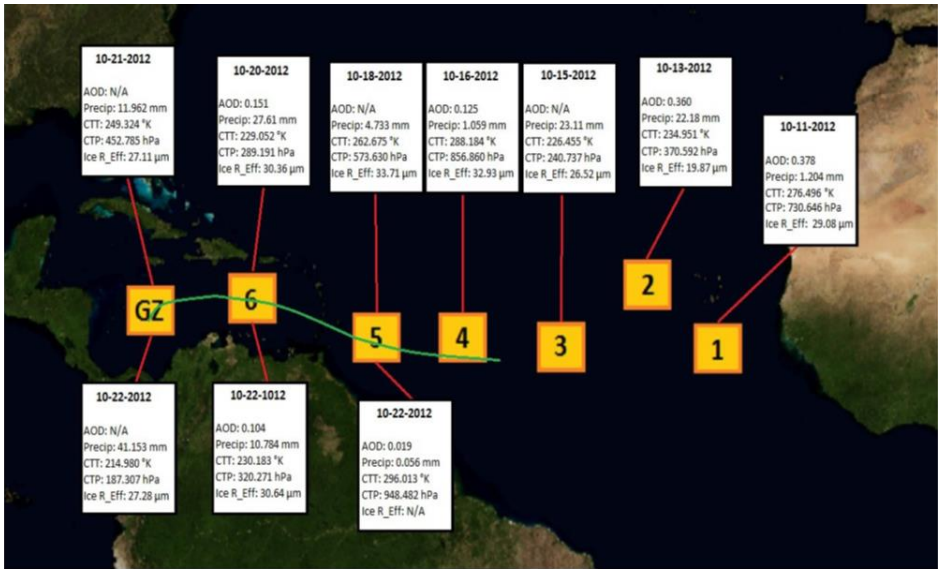
Courtesy of C. Pérez García-Pando

Applications: examples

- Weather and climate
  - Dust Impact on Hurricanes formation



(*Strong, Vecchi and Ginoux, 2015*)

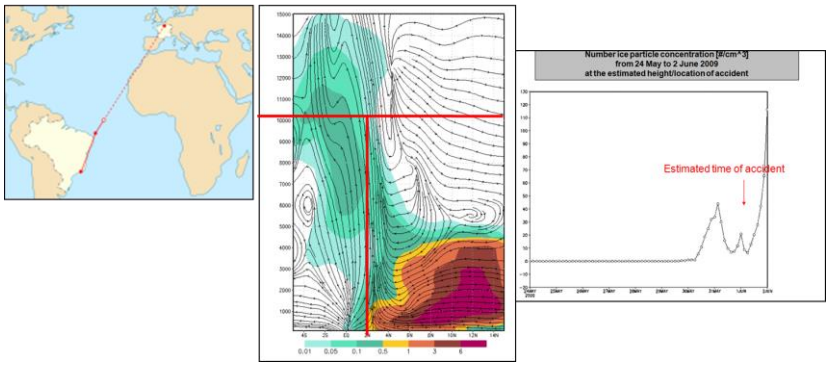


Characterizing the Impact of Aerosols Pre-Hurricane Sandy in 2012 (*Fontenot et al., 2018, In press)*

Applications: examples

- Aviation
  - Visibility
  - Ice nucleation
  - Dust melting in turbines
  - Turbine abrasion

AirFrance 2009 accident
(icing due to dust?)



EGYPTAIR - ACCIDENT CAUSED BY DUST STORM

http://edition.cnn.com/2002/WORLD/africa/05/07/tunis.crash/index.html
TUNIS, Tunisia (CNN) 7 May, 2002, 17:44 GMT -- An EgyptAir jet crashed on a hillside outside Tunisia's capital Tuesday as the pilot attempted to make an emergency landing, killing at least 18 people, a government official said...

...Weather was foggy and rainy at the time, with **sandstorms** blowing in from the Sahara Desert. ...

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

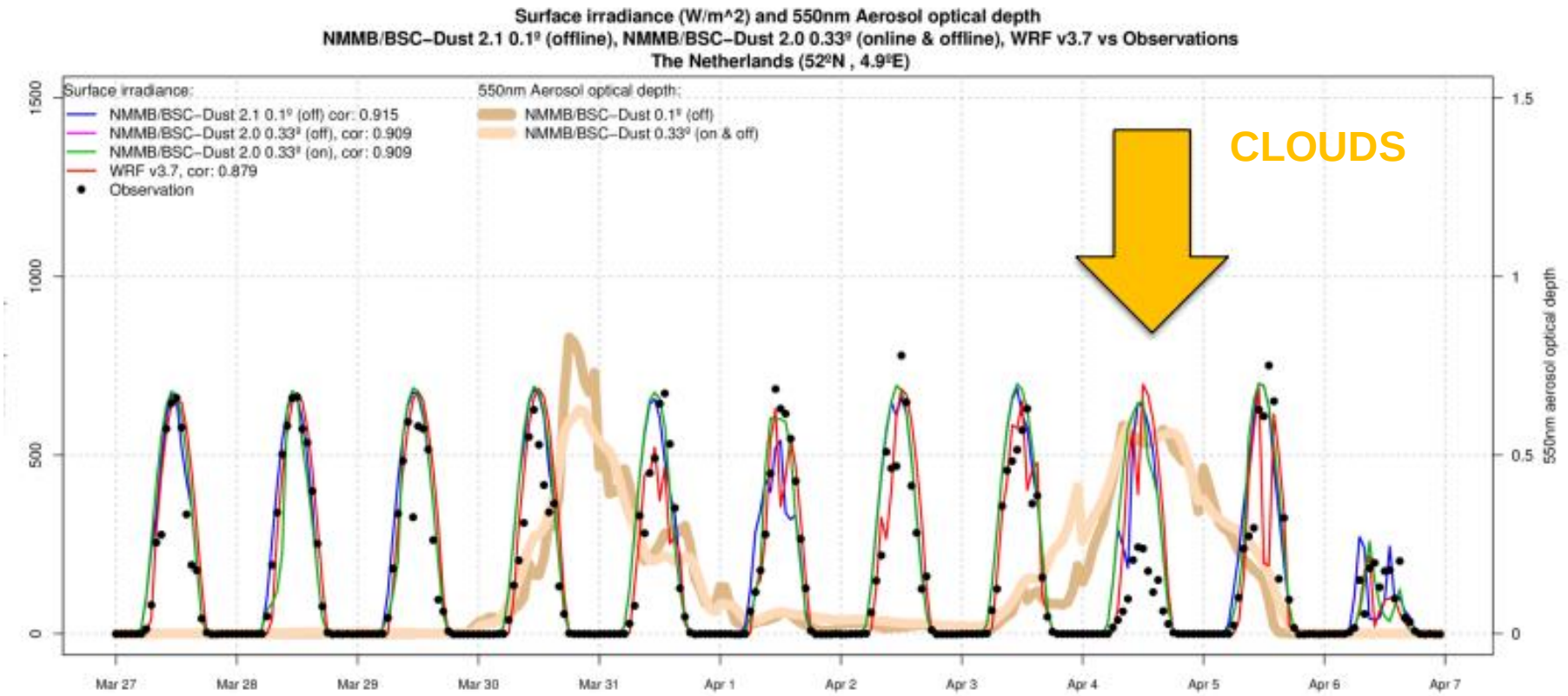
Applications: examples

- Ground transportation
  - Traffic disruptions (e.g. The Meca train)

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Applications: examples

- Solar energy
  - Solar irradiance → the presence of dust reduce the incoming solar irradiance through direct radiative effect but also indirectly, through favouring cloud formation



Year 2014

(Soret et al., 2016)

Applications: examples

- Solar energy
  - Soiling → panels efficiency and water management

Applications: More examples...

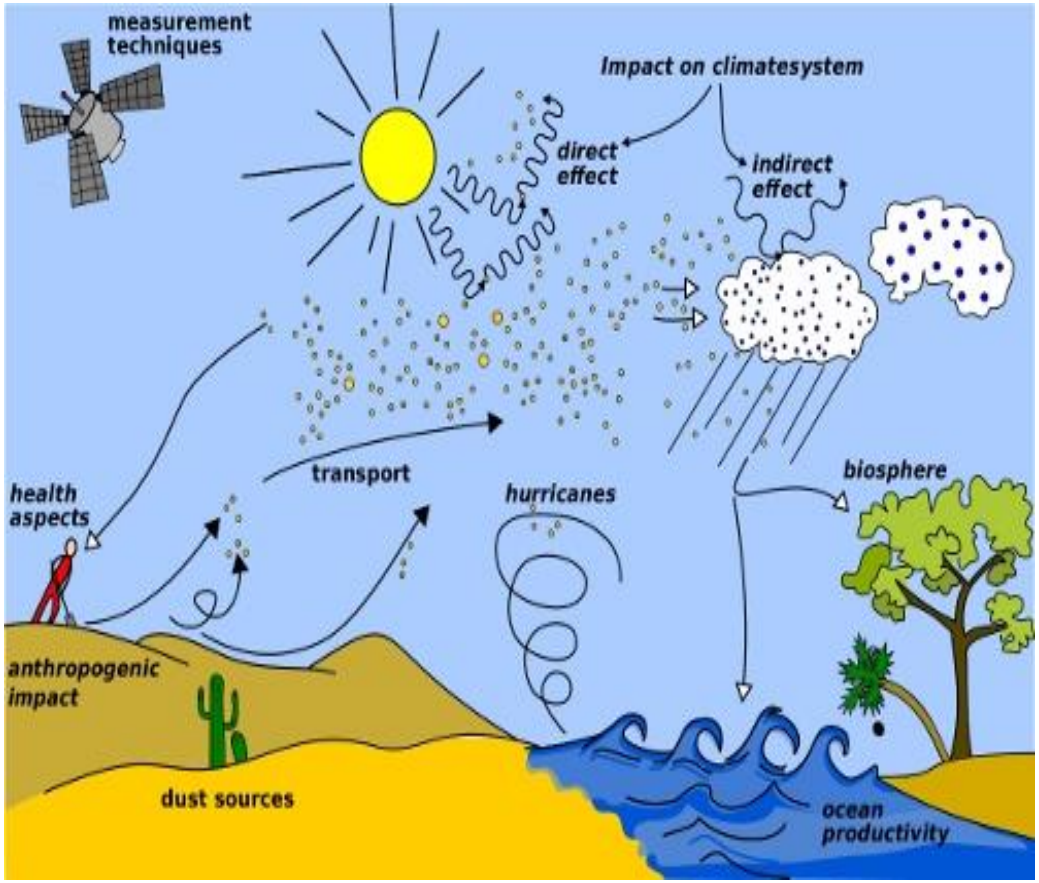


Image from WMO website (http://www.wmo.int/pages/prog/arep/wwrp/new/hurricanes.html)

Ecosystems, meteorology and climate

Air Quality and Human Health

Aviation and Ground Transportation

Energy and industry

Agriculture and fishering

Astrophysics

…

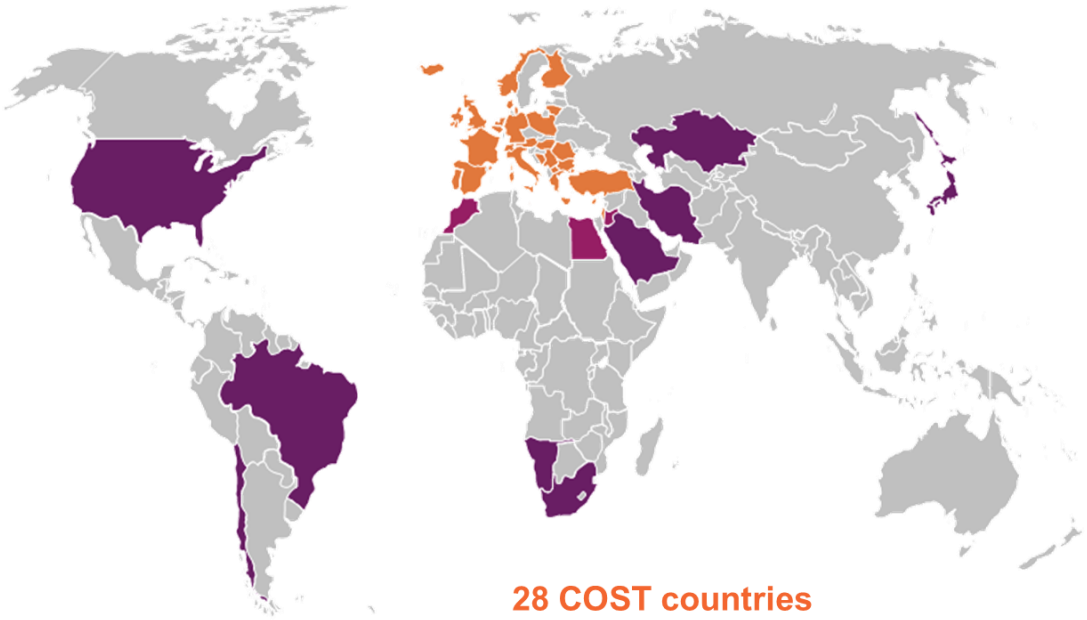
Applications: More examples...

- Car cleaning management

inDust

Who

- Currently the network includes more than 180 participants from more than 70 research institutions and private companies



28 COST countries
3 NNCs
9 IPCs
1 International Body (WMO)

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

inDust

Who

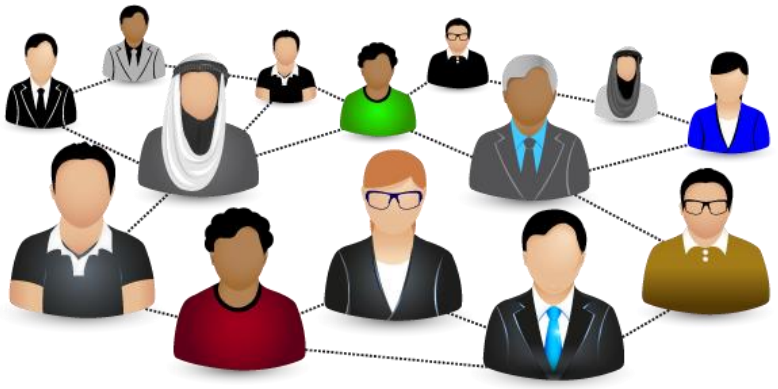
Dust Researchers on:

- Satellite products
- Ground observations
- Dust forecasting models
- Climate
- Socio-economic impacts

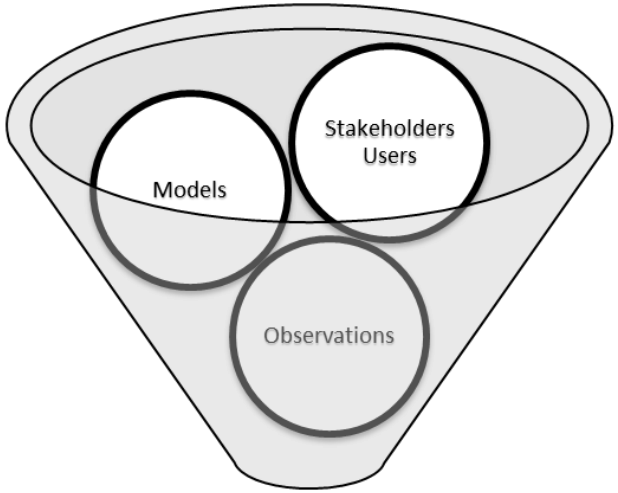
Other Users:

- Solar energy
- Aviation
- Air Quality
- Health
- International bodies (WMO, UNCCD, …)

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY



How… Concept approach



Dust-related Services

- WG1 Dust observations
- WG2 Dust modelling and forecast
- WG3 Assessment of user and societal benefits
- WG4 Transfer of dust products to user-oriented application and service value

inDust

How

- Identify scientific and technical **gaps in "dust" research**
- Coordinate and harmonise the process to get **user-oriented products**.
- **Build capacity** through the high-level teaching of users to promote the use of the delivered dust products.
- **Train staff** to properly use the available observational and forecast products to design and implement preparedness and mitigation measures.
- **Enhance the cooperation** with institutions from near-neighbouring and international partner countries in Northern Africa and the Middle East.

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

www.cost-indust.eu
Contact: cost-indust@bsc.es

inDust

THE ACTION PEOPLE GRANTS EVENTS MEDIA ROOM GET IN TOUCH MEMBERS AREA

EVENTS

› EVENTS

Updated information about interesting events, such as conferences, workshops, webinars or training courses, organised or related to **inDust** will be published in this section.

INDUST EVENTS RELATED EVENTS

inDust

1st inDust Joint Working Group Meeting,
14-15 March 2018, Barcelona, Spain

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

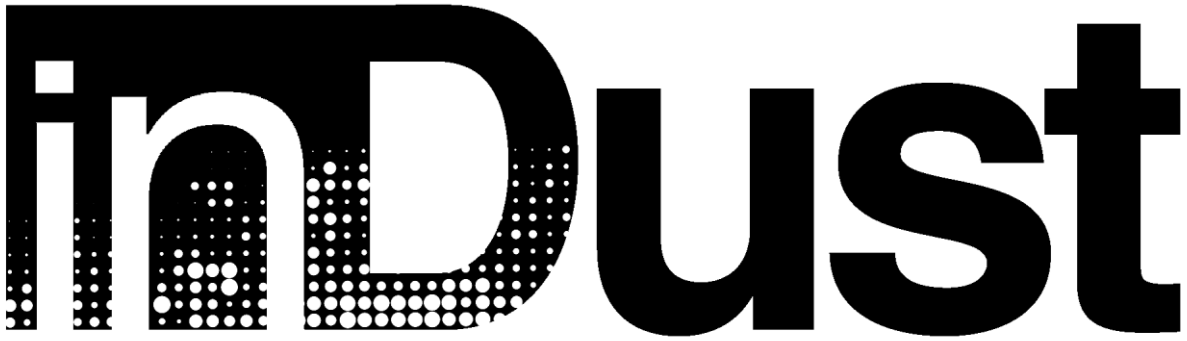
Summarising

- Sand and Dust Storms (SDS) play a significant role in different aspects of weather, climate and atmospheric chemistry and represent a **serious hazard** for life, health, property, environment and economy.
- Understanding, managing and mitigating SDS risks and effects requires fundamental and cross-disciplinary knowledge.
- **inDust** searches to build a community of researches and users that can start to design the strategy to develop **dust services**.

Tehran, Iran, June 2014

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Thanks for your attention!



COST Action CA16202

www.cost-indust.eu
Contact: cost-indust@bsc.es

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

AXA Research Fund